Department of Energy

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30 NOV 2000

Mr. James A. Saric, Remedial Project Manager
U.S. Environmental Protection Agency
Region V-SRF-5J
77 West Jackson Boulevard
Chicago, Illinois 60604-3590

DOE-0176-01

Mr. Tom Schneider, Project Manager
Ohio Environmental Protection Agency
401 East 5th Street
Dayton, Ohio 45402-2911

Dear Mr. Saric and Mr. Schneider:

TRANSMITTAL OF RESPONSES TO U.S. ENVIRONMENTAL PROTECTION AGENCY AND OHIO ENVIRONMENTAL PROTECTION AGENCY COMMENTS ON THE DRAFT HIGH PURITY GERMANIUM DETECTOR CORE COUNTER CALIBRATION REPORT

References: 1) Letter, T. Schneider to J. Reising, "Comments on HPGe Core Counter Calibration Report," dated November 1, 2000

2) Letter, G. Jablonowski to J. Reising, "Conditional Approval of the HPGe Core Counter Calibration Report," dated November 2, 2000

Enclosed for your approval are responses to the U.S. Environmental Protection Agency (U.S. EPA) and Ohio Environmental Protection Agency (OEPA) comments on the draft High Purity Germanium Detector (HPGe) Core Counter Calibration Report.

If you have any questions regarding this document or need further information, please contact Robert Janke at (513) 648-3124.

Sincerely,

for Johnny W. Reising
Fernald Remedial Action
Project Manager

FEMP:R.J. Janke

Enclosure

cc w/enclosure:
R. J. Janke, OH/FEMP
G. Jablonowski, USEPA-V, SRF-5J
T. Schneider, OEPA-Dayton (three copies of enclosure)
F. Bell, ATSDR
M. Schupe, HSI GeoTrans
R. Vandegrift, ODH
F. Hodge, Tetra Tech
AR Coordinator, Fluor Fernald, Inc./78

cc w/o enclosure:
K. Chaney, EM-31/CLOV
N. Hallein, EM-31/CLOV
A. Tanner, OH/FEMP
D. Allen, Fluor Fernald, Inc./52-8
D. Carr, Fluor Fernald, Inc./2
J. Chiou, Fluor Fernald, Inc./52-0
R. Danahy, Fluor Fernald, Inc./52-8
T. Hagen, Fluor Fernald, Inc./65-2
J. Harmon, Fluor Fernald, Inc./90
S. Hinnefeld, Fluor Fernald, Inc./31
M. Jewett, Fluor Fernald, Inc.52-2
U. Kumthekar, Fluor Fernald, Inc./52-2
C. Seiller, Fluor Fernald, Inc./52-8
C. Sutton, Fluor Fernald, Inc./35
T. Walsh, Fluor Fernald, Inc./65-2
J. White, Fluor Fernald, Inc./52-8
ECDC, Fluor Fernald, Inc./52-7

RESPONSES TO OHIO ENVIRONMENTAL PROTECTION AGENCY COMMENTS ON THE DRAFT HPGe CORE COUNTER CALIBRATION REPORT (20301-RP-0005, REVISION A)

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

Commenting Organization: Ohio EPA | Commentator: ODH
Section #: | Pg. #: | Line #: | Code:
Original Comment #: 1

Comment: It was not clear in the text exactly how consistent density measurements for each core sample were being obtained due to possible slumping and/or compression of the core during sampling. Perhaps a sensitivity analysis would be useful in determining the size of voids that will not introduce unacceptable errors into the measurement. SOPs should be developed which specify that no measurements should be taken when unacceptably large voids are present.

Response: The Core Counter detects the gamma flux coming from a 6-inch core segment. There will always be some degree of sample self-absorption in any sample. This only becomes important when the gamma energies of interest are low and/or the thickness of the sample is large. When voids are present in a 6-inch core segment (whether the presence of the voids is known or unknown), there are competing effects. If there is less soil because of voids, the gamma flux from this segment will be less than that from a voidless segment. Since the Core Counter detects a reduced flux, it will interpret this as a reduced total activity in the segment. If we don't realize there are voids in the segment, we will divide the measured total activity by too large a mass, thus obtaining a uranium concentration that is <u>too low</u>. On the other hand, the presence of voids in a segment effectively reduces the density of that segment. This will reduce the gamma ray absorption in the segment that has voids, which results is a slightly <u>higher</u> uranium concentration from the Core Counter. Because of the exponential nature of gamma ray absorption, the latter effect will not completely compensate for the former effect. Overall there will be a net reduction in the uranium concentration read from the Core Counter when unknown voids are present in a core segment.

If one assumes a certain void size to be present in a core segment containing soil with a constant uranium concentration, the true concentration can be calculated by properly accounting for the "missing" soil mass. If the void size is equal to 20 percent of the segment volume, then the true soil mass and the total activity in that segment are reduced by 20 percent, and the true concentration remains unchanged. However, a different uranium concentration will be computed if the void space is ignored. Numerical analyses to determine the effect of voids on the computed versus the true uranium concentration was performed for both the dual tubes and the macro cores. Actual tube dimensions were used in conjunction with a range of assumed void volumes. In the case of a dual tube, this analysis revealed that a cylindrical void, having a radius equal to the tube radius, with a cylinder length of 0.5 inches would result in only an 8.3 percent error in the calculated uranium concentration. A 1-inch long cylindrical void in a dual tube core would result in a 16.7 percent error. Corresponding void sizes in a macro core tube (i.e., cylindrical voids 0.5 and 1.0 inches long, each having a radius equal to the tube radius) will result in 10.1 and 20.6 percent errors, respectively, in the computed uranium concentration of these core segments. Voids of these dimensions will be easily visible.

Based on the numerical analyses described above, Fluor Fernald does not anticipate having unobservable voids in core segments that are large enough to introduce significant bias into Core Counter results. While there may be voids at either end of the 4-foot core tube, the compressive forces involved in driving the tube into the ground to obtain a sample make it unlikely that there will be sizeable voids in the core interior. To avoid generating results that are biased low because of voids in a core segment, Fluor Fernald will revise the Core Counter operations procedure to prohibit the counting of core segments that have void spaces greater than or equal to 1 inch in length. If a given project deems it important to obtain readings on such segments, the core samples may be tamped to reduce the voids to an acceptable size before they are counted in the Core Counter. This will only be done in consultation with a project geologist or other knowledgeable project staff.

Action: The Core Counter operations procedure, EQT-35, Soil Core Sampling System, will be revised to prohibit counting core segments that have voids greater than or equal to 1 inch in length without first consulting with cognizant project personnel and taking actions, such as tamping the soil, to reduce the void size to an acceptable level.

Commenting Organization: Ohio EPA Commentator: ODH
Section #: Pg. #: Line #: Code:
Original Comment #: 2

Comment: A strategy to radiologically map core sample lengths (with a GM) would give advance notice that the contributions of higher activity segments to proximal lower ones might occur.

Response: Agreed. A procedure has been written to ensure that field technicians will operate the Core Counter in a proper and consistent manner. This procedure is entitled EQT-35, Soil Core Sample Counting System. In that procedure, field technicians are instructed to mark 6-inch intervals on the outer surface of each 4-foot core liner. They are further instructed to "frisk" the entire core surface with a GM pancake probe, and to mark an X at the location of the highest GM frisker reading within each 6-inch core segment. The technician is required to rotate the core tube so that the X marking the highest GM reading is nearest the detector face during analysis of each segment.

Action: A requirement to frisk each core sample with a GM detector is already included in the procedure that governs the operation of the Core Counter.

Commenting Organization: Ohio EPA Commentator: ODH
Section #: Pg. #: Line #: Code:
Original Comment #: 3

Comment: As the manufactured standards anchor the calibration equations and subsequent precertification decisions, it would serve another test for accuracy to have them independently analyzed offsite. Are there any plans to have the standards analyzed at another lab?

Response: There are no plans to have the standards analyzed at another lab because this would alter the standards. Laboratory analyses would result in consumption of some of the standard materials during analysis and would thus alter the gamma flux emitted by each standard. Although it was not mentioned in the HPGe Core Counter Calibration Report, each standard was analyzed before packaging by two independent laboratory techniques: gamma spectrometry and inductively coupled plasma-mass spectrometry (ICP-MS). The ICP-MS results corroborated the gamma spectrometry results. Then the standards were sealed in core tubes to prevent loss or alteration of the standard materials. Fluor Fernald believes that the agreement between two independent analytical techniques is sufficient documentation of the radionuclide content of the standards.

Action: No additional action will be taken.

RESPONSE TO U.S. ENVIRONMENTAL PROTECTION AGENCY TECHNICAL REVIEW COMMENT ON THE DRAFT HPGe CORE COUNTER CALIBRATION REPORT (20310-RP-0005, REVISION A)

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

SPECIFIC COMMENT

Commenting Organization: U.S. EPA   Commentor: Jablonowski
Section #: 3.0   Page #: 3-2   Line #: 1
Original Specific Comment #: 1

Comment: The text on Page 3-2 states that variations in soil density over the range of 1.1 to 1.68 grams per cubic centimeter (g/cm^3) would have a negligible effect on high-energy gamma emissions of uranium. This statement is true if it refers to absorption of the radiation by the soil itself. However, if a soil sample with a density of 1.68 g/cm^3 has the same uranium concentration as another sample with a density of 1.1 g/cm^3, the denser sample will emit more than 1.5 times the high-energy gamma flux emitted by the less dense sample. Because the core counter analysis is based on count rates for a fixed sample volume, these two samples would appear to have different concentrations. The text seems to confuse an extensive quantity (mass) of uranium in soil with an intensive quantity (concentration) of uranium. The text should be revised to explain how soil density variations will be accounted for during use of the HPGe core counter.

Response: The U.S. EPA comment deals with text on Page 3-2 of the HPGe Core Counter Calibration Report and the issue of core sample density variations. In this section of the report, it was pointed out that the process of collecting core samples could result in density variations because of the way the soil gets packed into the core tubes. The report simply intended to convey the notion that density variations would give rise to variable levels of sample self absorption, but these effects would be much less pronounced for 1,001 Kev gamma rays than for 63 Kev or 93 Kev gammas.

The soil core density will vary from core to core and probably also from segment to segment within a single core. This occurs because soil type and moisture content vary from location to location and with depth at a single location. Also, the process of collecting core samples can alter the soil density somewhat because of compressive forces that result from driving core tubes into the ground. The range of densities quoted on Page 3-2 of the report referred to densities of the calibration standards rather than to actual core sample densities. The range of densities encountered in actual core samples may not be as wide as that found in the calibration standards. However, since gamma attenuation coefficients of bulk materials are not rapidly varying functions of energy or density, it is reasonable to expect that core sample densities will be close enough to calibration standard densities so that the self absorption properties of the samples will not be markedly different, especially at gamma energies above 1,000 Kev.

There is no practical way to measure the density of each core segment in the field. This is one of the reasons for adopting a WAC trigger level that is lower than the actual waste acceptance criterion of 1,030 ppm. As stated in the Core Counter report, when a blank-corrected and moisture-corrected core counter result exceeds the trigger level (19.2 ppm total uranium for dual tube cores or 30.6 ppm for macro cores), that segment will be treated as being above WAC. When the applicable calibration equations are applied to these core counter readings, the lab equivalent dry weight results are approximately 850 ppm. The establishment of a trigger level that is 82 percent of the actual WAC should be adequate to compensate for inaccuracies caused by core sample density variations.

Another point to bear in mind is that the Core Counter will be used primarily in the predesign phase of a remediation project. In later remediation phases, the subsurface intervals identified as above-WAC will be excavated. The soil beneath the above-WAC zone will again be evaluated with NaI or HPGe detectors to confirm removal of all above-WAC soil. In situ measurements conducted to support soil excavation will cover a much larger volume of soil, and thus will represent a more accurate characterization. This additional scanning should provide the opportunity to improve upon inaccuracies that may result from extrapolating Core Counter results to larger volumes of soil.

Action: No additional action will be taken.

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